勞 動 經 濟 論 集
第29卷(1), 2006. 4, pp. 1~39

Earnings Variability and Capital Market Opening*

Dae Il Kim**

This paper documents the increase in earnings variability (or earnings risk) during the 1990s in Korea, and investigates whether it can be accounted for by capital market opening. The variances of transitory and permanent innovations in earnings are estimated from repeated cross-section data using a simple econometric framework. The increasing time-series pattern of earnings risk among men follows the increased foreign capital presence reasonably well, but the supporting cross-sectional evidence for a causal relationship between the two is weak. However, foreign direct investment (FDI) is found to have had some non-neutral effects on workers of varying skills in such a way that transitory earnings risk of less-skilled workers relatively increased with FDI. To the extent that transitory innovations are not fully insured, this widening effect of FDI on earnings risk gap may have contributed to widening welfare gap between skilled and unskilled workers in Korea, at least in terms of "risks."

Key Words : Earnings Risk, Capital Market Opening, Capital-Skill Complementarity

* This paper is written while the author is visiting the NY State School of Industrial and Labor Relations at Cornell University. The author is grateful to Fulbright Research Award and the financial support from Seoul National University. The author is also grateful to Dr. Dong-Seok Kim for providing valuable data and comments. The usual caveat applies.

** School of Economics, Seoul National University(dikim@snu.ac.kr)

Ⅰ. Introduction

This paper empirically investigates from Korea's experience during the 1990s whether the presence of foreign capital increases earnings risk of workers. Two types of foreign capital, foreign direct investment and equity capital, are considered. Although the time-series pattern of the increase in foreign capital presence coincides with the increase in earnings risk in Korea, cross-industry evidence based on 2SLS estimates produce weak association between foreign capital presence and earnings risk among the Korean workers. However, foreign direct investment is found to have some explanatory power for the educational gap in earnings risk.

Wage inequality has been rising since the mid-1990s in Korea's labor market, until when it had been steadily decreasing. Gini coefficient estimated from 25~54 years old male wage/salary workers rose from .202 in 1995 to .246 in 2003. Alternatively, the 90-10 percentile differentials of log monthly wages rose from 1.070 in 1995 to 1.260 in 2003 in the same working population. It is important to note that wage inequality can increase for two reasons; first, an increase in wage differentials among various worker groups can cause widening inequality; second, even when average wage differentials remain constant, earnings variability, or earnings risk, can cause a widening in inequality. I focus in this paper on the changes in earnings variability and investigate empirically whether they are associated with capital market opening that has taken place during the 1990s in Korea.

There has been a large body of literature on widening wage differentials, but changes in earnings variability have only recently received attention.[1] Moffit and Gottschalk

1) Wood (1994a), Feenstra and Hanson (1996), Leamer (1996), and Dasgupta and Osang (2002), for example, argue that increased trade with developing countries and outsourcing have played a significant role in widening skill differentials.* Berman, Bound and Grillichs (1994), Lawrence and Slaughter (1993), Haskel and Slaughter (1998), Johnson and Stafford (1999), and Krusell *et al* (2000) point to skill-biased technological changes for the main cause of rising skill premium.**

(1995) report that residual earnings variability increased by almost 40% between 1970 and 1987 in the US, and Cameron and Tracy (1998) report that variability in permanent components in earnings kept increasing in the early 1990s. Even newer are the studies on potential association between international trade and earnings variability. Rodrick (1997) argues that increased foreign competition will increase the elasticity of goods and derived labor demand, which in turn results in larger variations in wages and employment given a shock. Krebs, Krishna and Maloney (2004) empirically study the relationship between trade policy and individual income risks using the Mexican data, and report that tariff level changes have a significant short-run effect on income risks.

A natural extension of these studies would be a study on the potential association between capital market opening and earnings risks faced by individual workers. First of all, Rodrick's argument can easily be extended to capital market opening. Further, high mobility of capital and herd behaviors of international investors in integrated capital market can cause rational contagion among countries (Calvo and Medonza, 2000), and the risk-aversion of foreign investors in a bank-run type model also predicts an association between integration and crisis (Nilsen and Rovelli, 2001). These may increase wage and employment risks faced by individual workers.[2)]

There has been a related concern that global integration can lead to a greater job risk among workers in both developing and developed countries.[3)] Increased capital mobility

---

Most of these studies on the effects of trade on wage inequality have focused on the changes in wage differentials among workers of varying education or skill levels.

* Wade (2004) questions the empirical evidence in favor of neoliberal argument that global integration helps economic growth and reduces poverty. Seshanna and Decornez (2003) also argue that income polarization has not been improving through the period of global integration.

** Cline (1997) offers a comprehensive survey of the literature, but the true extent of trade's effects on wage inequality is still on debate. See also Ethier (2005) for the effect of globalization.

2) The severe impact on wages and employment of the Asian financial crisis in the late 1990s also suggests the possibility that integrated capital market may increase wage and employment risks faced by workers. Indeed, risk of a crisis in an integrated market appears to be sufficient to induce greater variability in wages and employment of "immobile" labor.

3) In developing countries, quick inflows and outflows of hot money through integrated capital market have been often blamed for economic instability. Calvo and Mendoza (2000), for example, consider the induced herd behavior of investors from costly information gathering for the cause of the Central and South American financial crisis and the recent crisis in Asia. See

may increase economic uncertainty, which forces firms to change employment and production decisions, and there must be some truth in these concerns. Earnings risk, if not properly self-insured, reduces the welfare of risk-averse workers, and thus it is directly associated with welfare. However at the same time, increased capital mobility may also mean an increase in supply elasticity of capital, which will reduce the magnitude of economic fluctuation arising from certain domestic shocks. Thus whether workers are truly exposed to a greater structural risk as a result of capital market opening is an empirical issue.[4)]

A related question is whether the effects of foreign capital presence on earnings risk, if any, differ among various worker groups. Skill-capital complementarity is well theorized and documented in literature (for example, Krusell *et al*, 2000), and such complementarity is even more probable if technology is also embodied in capital. Thus inflow of foreign capital is likely to affect skilled workers more favorably increasing their demands. Greater capital stock and higher technology may lead to stabler wages and jobs for skilled workers because of the complementarity between skill and capital given a shock. Given relative substitutability between capital and unskilled workers, firms may find it easier and more profitable to absorb economic shocks by adjusting wages and jobs of unskilled workers. In addition, the "foreignness" of capital also comes with foreign management style that relies more on labor cost minimization. It is also possible that foreign ownership of equity capital leads firms to focus more on maintaining short-term profits, which tend to increase volatility of unskilled workers' jobs and wages relative to skilled workers who perform core functions. Thus whether the effects of foreign capital on earnings risks differ among workers is also an empirical question.

Despite the seemingly natural extension of the trade-risk argument to capital market

---

also Knight (1998) for an account for the Asian Crisis based on the "contagion" effect. In developed countries, export of domestic capital can eventually cost domestic jobs (e.g. Eckel, 2003).

4) The labor market impacts of capital market opening may depend on other aspects of the economy as well. For example, Bertocchi (2003) considers the labor market structure such as union presence as a factor determining the effect of capital market integration on labor market outcomes.

opening-risk argument, few empirical studies have been put forth on the issue. There could be many reasons for the apparent lack of studies on the issue, and probably the most important one is that lack of detailed labor market data at the time of capital market opening in most advanced countries. Korea is an interesting case in this regard as capital market opening was rather a recent event and labor data have long been available. Various regulations on FDI have been lifted during the 1990s, stock market opening in 1992 was completed by 1998, and bond market opening was also completed in 1998. Such relatively quick capital market opening in Korea offers an almost natural experiment from which one can estimate its impact on labor markets.[5)]

I estimate in this paper earnings variability from the Korean data and investigate whether the time-series/cross-section patterns of earnings variability can be empirically linked to the extent of capital market opening. The empirical results suggest that, although capital market opening and the increase in earnings risk coincide in timing in Korea, the cross-sectional evidence is not strong. One interesting finding is that the presence of foreign capital through foreign direct investment has a differential effect on earnings risk depending on worker skill levels. It is found to have increased earnings risk of less-skilled workers while reduced that of skilled workers. This is consistent with the empirical and theoretical complementarity between skill and capital documented in Freeman (1986), Hamermesh (1986), Wood (1994a, 1994b) and Krusell et al. (2000).

II. Extent of Capital Market Openness

Although product market has been quite open to international competition, capital market has relatively been closed to foreign investors until the early 1990s in Korea. Capital inflows and outflows had been tightly controlled by the government, and most of

5) Capital market opening was an agreement between the OECD and Korea when Korea joined the former. The schedule of market opening was shortened through the agreement with IMF on emergency loans during the financial crisis in 1997.

foreign capital inflows took the form of foreign direct investment or syndicated loans which were subject to government's approval and control. Capital outflow through direct investment in foreign countries was also tightly controlled. The million-dollar cap on FDI outflow was lifted in 1989, but .3 million dollar and 30% of the previous year's sales caps were placed again in 1994 on individual investors and firm-level investors, respectively.

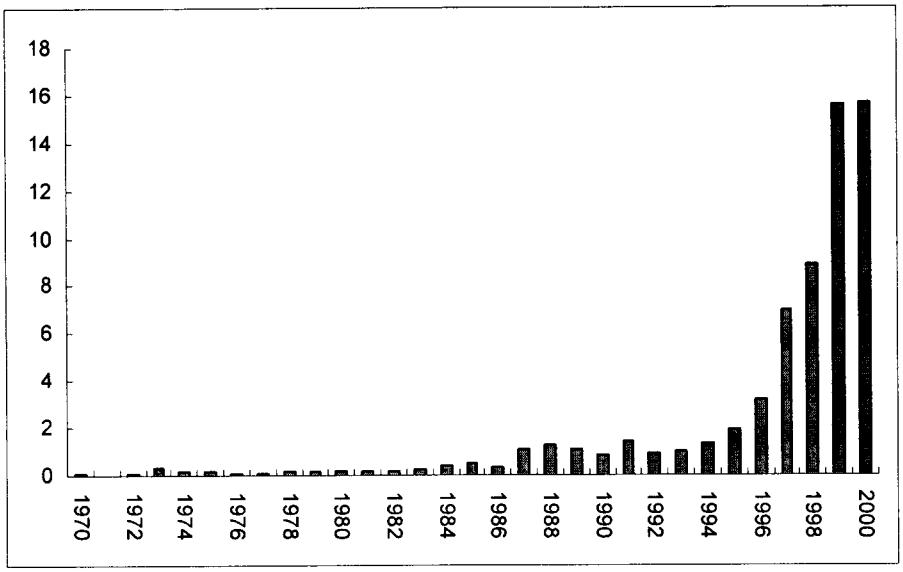
A major step toward integrated capital market was the equity market opening in 1992. Foreign investors were allowed then to trade the listed firms in Korea Stock Exchange, with a 3% cap on individual ownership and a 10% cap on aggregate foreign ownership. These caps were gradually lifted in the ensuing years until they were completely lifted in 1998. Bond market was partially opened in 1994 to foreign investors, and it was completely opened in 1998, too. Friendly M&A by foreign investors was allowed in 1997, and hostile M&A market was opened in 1998. That is, most capital market opening to foreign investors was completed in 1998 in Korea, which was partly a result of the agreement with IMF on restructuring loans during Korea's financial crisis.

Fig. 1 shows the extent of capital inflow through foreign direct investment and equity ownership. The annual amount of direct investment (net inflow) was around $1 billion until the mid-1990s, but it grew rapidly during the late 1990s reflecting deregulation on capital inflow into retail/wholesale trades and service sectors. Stock ownership by foreign investors gradually increased until the mid-1990s reflecting gradual relaxation of the cap, but it took off during the financial crisis both in terms of amounts and fraction owned. The fraction owned by foreign investors reached 30% by 2000, which further increased beyond 40% in 2004. Foreign investment in corporate and government bonds has relatively been inactive, and the fraction owned by foreign investors of corporate and government bonds was 0.51% in April 2000.

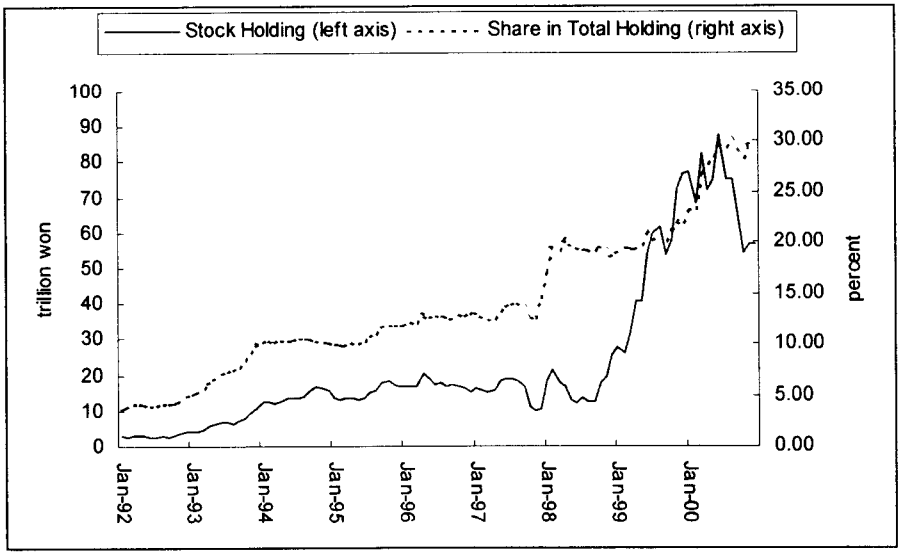
In a Heckscher-Ohlin world, capital mobility would be a substitute for goods mobility. Thus one would expect a greater capital inflow into non-traded sectors such as retail/wholesale, banking, and service sectors. Table 1 reveals mixed results. Sectoral pattern of capital inflow through foreign direct investment tends to indicate that the growth rate of foreign capital's presence through FDI is higher in F.I.R.E. and service

Fig. 1. Foreign Direct Investment and Firm Ownership in Korea

(1) Foreign Direct Investment ($billion)



(2) Foreign Ownership of Listed Firms



Source: Bank of Korea.

sectors, which are traditionally non-tradeable sectors. Thus FDI, at least partly, appears to have worked in Heckscher-Ohlin way by moving capital across borders among non-tradeable service sectors. However in terms of foreign capital invested in ownership, manufacturing has been one of the sectors that attracted foreign capitals most. Banking and insurance (denoted as F.I.R.E.) have attracted most foreign capitals, and manufacturing has been the next. Traditionally non-tradeable sectors, wholesale/retail trades and services, have attracted much less capital in terms of foreign ownership.

The results in Table 1 suggest the possibility that capital inflow may not always be simply substituting goods trade as in the traditional Heckscher-Ohlin trade model. Inter-sectoral pattern of the increase in foreign ownership and trade within manufacturing also suggests the same. Value-added weighted correlation of foreign ownership changes with import changes between 1992 and 2000 across 10 manufacturing sectors is positive at .301, and that with export changes is also positive at .326. That is, foreign ownership of the Korean firms increased more among sectors with faster trade growth during the 1990s.

There is no doubt that foreign capital inflow has been induced by the expectation of higher returns, , but one can consider one important difference between FDI and foreign investment in stocks. FDI inflow is more likely to be based on long-term prospective of return streams than foreign fund's purchase of the Korean firms' stocks. Short-term expectation plays a greater role for the latter. The difference arises from the "reversability," or the "mobility." FDI capital inflow is not easy to reverse, especially when it is already spent to build factories and buy machines. In contrast, stocks can always be easily liquidated, and thus such capital is highly mobile.

Table 1. Increase in Foreign Capital Presence between 1992 and 2000

	Manufacturing	Wholesale & Retail Trades	F.I.R.E.	Services
FDI Capital Stock	407.1%	348.3%	651.7%	583.7%
(Aggregate Capital Stock)	(62.3%)	(75.1%)	(101.5%)	(157.3%)
Stock Ownership	1,040.8%	527.6%	1,029.9%	121.6%+

Note: (+) percentage growth between 1996 and 2000.

This difference has an important implication for a possible association between capital market opening and worker vulnerability (earnings and employment risks). Given that the investment decision is more likely to be based on a short-term gain in stock market, and also that capital is highly mobile in the market, earnings risk of individual workers is more likely to be associated with foreign capitals in stock markets, if there is any association between capital market opening and worker risks.

III. Structure of Earnings Variability

1. Data and Methodology

Risks faced by individual workers in labor markets are of various types. Workers may be exposed to a greater variability of earnings either through working hours or hourly earnings, and also to a greater possibility of job losses. Thus the effect of capital market opening on worker vulnerability, if any, will also appear in various ways. Studying all these effects, however, is beyond the scope of this paper, and I focus on earnings risk. The focus on earnings risks is motivated from the observation that earnings inequality has been widening since the mid-1990s in Korea.[6] I focus on wage/salary workers of age 25~54, as these are the groups for which a large data set is available.

Measurement of earnings variability typically requires an individual panel survey which follows each individual for years. Given that Korea's capital market had mostly been closed to foreign investors until the early 1990s, an analysis of the effects of capital market opening on earnings variability would naturally require long time-series data covering the periods before and after the capital market opening. Unfortunately however, such a long panel survey does not exists in Korea. Instead, the existing panel surveys have a small number of observations over a few years, and disaggregate analysis

6) See Yoo and Kim (2003) and Bourguignon and Goh (2004) for the recent increase in earnings inequality and earnings risk in Korea.

is almost impossible.[7] For lack of a suitable panel survey, I apply an econometric model to repeated cross-section data to identify the variances of earnings components.

Before laying out the model, I need to describe the data. The earnings data in this paper are extracted from the Wage Structure Survey, 1978~2003, administered by the Ministry of Labor. The survey is an establishment-level survey, providing information on each worker's demographic and job characteristics, and earnings for a random subsample of workers in each firm.[8] The main advantage of the survey is that it has quite a large number of observations, 300,000~500,000, depending on the year. Such a large number of observations allows me to disaggregate sample without too much sacrificing the estimates' precision. Further, it starts in the late 1960s covering a period of almost four decades. To maintain data quality, I use the year 1978 as the starting point. Further, I limit the sample to male workers. As it is a cross-section survey, however, certain structural model needs to be assumed to identify earnings dynamics.

I follow Bourguignon and Goh (2004) and Bourguignon, Goh and Kim (forthcoming) in modeling earnings dynamics in repeated cross-sections, and explain it below. The basic idea is to use cohort and time variation in error variances in earnings equation to identify some key parameters determining earnings dynamics. First, individual earnings are parametrized as in equation (1).

$$\log(W_{it}^{c}) = X_{it}^{c}\beta_t + \xi_{it}^{c} \tag{1}$$

---

7) One true panel survey and a semi-panel survey are available in Korea, the Korea Labor Income Panel Study (KLIPS) and the Urban Working Household Survey (UWHS). The KLIPS, the true panel survey, started only in 1998, and its sample size is approximately 11,543 in 2003, among which only 5,592 has valid wage/salary information. Its short history and small sample size are not suitable for the current analysis. The UWHS, a semi-panel, has a longer series and includes more observations -- for example in 2003, it has valid wage/salary observations among 44,000 households. The survey provides information on each household's and its head's labor earnings. The main problem with this survey is that although households can be matched over time, each household's head changes. Thus it is just a household panel, not individual panel. Further matching quality of households in the 1980s are quite questionable.

8) For detailed discussion of the Wage Structure Survey, contact with Korea's Ministry of Labor homepage, http://www.molab.go.kr.

In the above, W_{it}^c is the real earnings of an individual i in birth-cohort c at time t, X_{it}^c is his/her characteristics vector including a time-varying variable such as age, and ξ_{it}^c is the stochastic component in earnings. β_t is the vector of regression coefficients on characteristics variables, X_{it}^c, or alternatively, it is the vector of skill prices, which are allowed to differ across time (t), but common to all cohorts at each point in time.

The stochastic component of earnings, ξ_{it}^c, is further decomposed into permanent and transitory components as in (2).

$$\xi_{it}^c = u_{it}^c + v_{it}^c \tag{2}$$

u_{it}^c is the permanent component and v_{it}^c is the transitory component. The permanent component represents the earnings accruing to unobserved individual ability, and the transitory component represents temporary fluctuation in earnings. These components are orthogonal to each other, or $E(u_{it}^c v_{it}^c) = 0$ for all i, c, and t.

I assume that the permanent component follows a random-walk process in order to allow price changes for unobserved skills among others, and I allow the transitory component to be serially correlated.

$$u_{it}^c = u_{it-1}^c + \eta_{it}^c \ , \quad \text{and} \quad v_{it}^c = \rho v_{it-1}^c + \epsilon_{it}^c \tag{3}$$

In equation (3), η_{it}^c is the innovation in permanent components, and ϵ_{it}^c is the purely transitory innovation. Orthogonality is assumed between these innovation terms: $E(u_{it-1}^c \eta_{it}^c) = 0$, $E(v_{it-1}^c \epsilon_{it}^c) = 0$, and $E(\eta_{it}^c \epsilon_{it}^c) = 0$ for all i, c, and t. Finally, ρ is the serial correlation coefficient in transitory component, and is assumed to be positive, or $\rho \in (0, 1)$. If a panel survey is available, GMM can be used to estimate the variance of each error component without further imposing any restrictions.[9]

9) See Meghier and Pistaferri (2004), Storesletter et al. (2004), and Gourinchas and Parker (2002) for the equally weighted minimum (EWMD) distance estimator. Also see Krebs, Krishna and

Absence of a sufficiently long and large panel survey in Korea makes it impossible to flexibly estimate the earnings variance components. Thus more structures need be imposed to estimate them from repeated cross-sections. The assumptions on variances of these error components are given below. I assume, in particular, that the innovation in permanent component has a constant variance over time, t, and across cohorts, c. The innovation in transitory component, however, is allowed to have a flexible and time-varying variances.

$$\begin{aligned} &Var\,(\eta_{it}^{c}) = \sigma_{\eta}^{2} && \text{common for all } c \text{ and } t \\ &Var\,(\epsilon_{it}^{c}) \equiv \sigma_{\epsilon t}^{2} = \sigma_{\epsilon}^{2} + \omega_{t} && \text{common for all } c, \text{ but not for } t \end{aligned} \tag{4}$$

The innovations in error components are assumed to have a common variance among cohorts because I expect them to reflect market-wide factors such as changes in returns to skills and/or fluctuation in goods and labor demands. I assume that these factors are age-neutral and only depend on time.[10]

The assumption that η_{it}^{c}, or the innovation in permanent component, has the same variance over time is restrictive, but a similar or even more restrictive model is not rare in the literature. For example, Carrol and Samwick (1997) impose the same restriction and use a similar method as this paper to estimate the error variances. Many other related studies often assume fixed permanent effects (e.g. Cameron and Tracy, 1998; Moffitt and Gottschalk, 1995).

From (3) and (4), the variance of permanent component, $\sigma_{ut}^{2}(c)$, of a given cohort c can be written as below.

Maloney (2004) who obtains the EWMD estimators for the variances of transitory and permanent innovations in errors for an analysis of the impact of trade liberalization on earnings risks.

10) The assumption of age-neutrality of the effects of market-wide factors requires high substitutability among workers of varying ages in labor market. Kim (2005) reports that age-structure of wages has been very stable within education groups in Korea during the 1990s when relative supply of age groups has changed substantially, and interprets the result as indicating high substitutability among young and old workers.

$$\sigma_{ut}^2(c) = \sigma_{ut^c}^2 + (t - t^c)\sigma_\eta^2 \tag{5}$$

In the above, t^c is the year in which birth cohort c enters the market, since which the innovation terms accumulate. Thus the variance of permanent component u_{it}^c is also a cumulative sum of past innovations' variances and the cohort's initial dispersion of $u_{it^c}^c$, or $\sigma_{ut^c}^2$. I assume that the initial dispersion of permanent components measured in $\sigma_{ut^c}^2$ differ among cohorts because ability distribution may differ among them. For example, recent cohorts are much better-educated, and thus their individual productivity at entry-level may have a different distribution from that of older cohorts even if their innate abilities were the same. Transitory component, however, is assumed to be cohort-neutral, and its variance to follow the time-series path described below.

$$\sigma_{vt}^2 = \rho^2\sigma_{vt-1}^2 + \sigma_\epsilon^2 + \omega_t \tag{6}$$

That is, cohorts may differ in their permanent effect's distribution but not in their transitory component distribution. Transitory component and the innovation in permanent effects are considered to be "aggregate" in the sense that they are cohort-neutral.

Combining (5) and (6), I obtain the following.

$$\begin{aligned} &Var(\xi_{it}^c) = A^c + B(t - t^c) + \rho^2\, Var(\xi_{it-1}^c) + \omega_t \\ &\text{where} \quad B = (1-\rho^2)\sigma_\eta^2, \quad \text{and} \\ &\qquad\quad A^c = (1-\rho^2)\sigma_{ut^c}^2 + \rho^2\sigma_\eta^2 + \sigma_\epsilon^2 \end{aligned} \tag{7}$$

The distinct feature of equation (7) is that the information extractable from repeated cross-sections suffices to identify the key parameters in earnings dynamics. First, individual error component in earnings, ξ_{it}^c, can be estimated as the residual in earnings equation (equation (1)). Then one can obtain the estimates on earnings variance, $Var(\xi_{it}^c)$, for each birth-cohort c and year t, which in turn can be used to estimate

equation (7) to identify ρ^2 and σ_η^2. Bourguignon, Goh and Kim (2004) show that the estimates from the above model reasonably approximate those from true panel using the Korean data.

In fitting equation (7) to the data, the unit of observation is birth-cohort and year cell, the dependent variable is earnings variance of cohort c at time t, and the main regressor is cohort c's lagged earnings variance. Additional regressors are the time past since the cohort's market entry, $t-t^c$, and dummy variables for cohort and year. Each cohort's market-entry time, t^c, is assumed to be when the cohort is 25 years old, or $t^c = c+25$. ρ^2 can be identified as the regression coefficient on the lagged residual variance $Var(\xi_{it-1}^c)$, and the time-invariant variance of permanent innovation (σ_η^2) can be consistently estimated from the coefficient on the time past since market-entry, $(1-\rho^2)\sigma_\eta^2$, given the estimate on ρ^2. Finally, ω_t is identified from the coefficients on year dummy variables.

As for the remaining parameters ($\sigma_{ut^c}^2$ and σ_ϵ^2), the estimates of ρ^2, σ_η^2, and A^c, the last of which is the coefficient on cohort dummy variables, are used to identify $(1-\rho^2)\sigma_{ut^c}^2 + \sigma_\epsilon^2$ by subtracting $\rho^2\sigma_\eta^2$ from A^c.

One identification problem is that $\sigma_{ut^c}^2$ and σ_ϵ^2 are not individually identified, and thus additional information or certain assumptions are required. But this does not pose a serious problem, at least, as far as this paper's primary interests lie in time-series variation in earnings variability, not in its levels. To see this, consider an arbitrary choice z for σ_ϵ^2. Then each cohort's initial variances of permanent components, $\sigma_{ut^c}^2$, are identified as $\sigma_{ut^c}^2 = (A^c - \rho^2\sigma_\eta^2 - z)/(1-\rho^2)$. As the variances of permanent components in ensuing years are $\sigma_{ut^c}^2 + (t-t^c)\sigma_\eta^2$, the choice of z affects $\sigma_{ut}^2(c)$ only through $\sigma_{ut^c}^2$ commonly for all t. Thus an incorrect choice of z may bias the estimates of $\sigma_{ut}^2(c)$, but not their time-series variation. Similarly, the variances of transitory component, σ_{vt}^2, which can be identified by iterating $\sigma_{vt}^2 = \rho^2\sigma_{vt-1}^2 + \sigma_\epsilon^2 + \omega_t$ or by subtracting $\sigma_{ut}^2(c)$ from $Var(\xi_{it}^c)$, may be biased if z is badly chosen, but its

time-series is not affected.

Given that earnings risk components are estimated from the above model applied to synthetic cohorts created from wage/salary workers in repeated cross-section data, not from panel data, it is important to understand what the "estimated" risks represent and what potential bias may exist in the estimates. In the absence of job losses and gains, the cohorts would represent the same wage/salary working population at different points in time and the estimated risks reflect wage variability among them. However as the cohorts at different points in time may include different wage/salary workers because of job losses and gains between the points, the measured earnings risk tends to understate true earnings risk. If the patterns and probabilities of job losses and gains have remained stable during the period, the time-series pattern of estimated earnings risk from repeated cross-sections can serve as a reasonable approximation of the actual series. The rate of job reallocation, losses plus gains, has been falling during the 1990s in Korea, surged substantially in 1998 due to the economic crisis, and stabilized at the pre-crisis level since then. Thus the time-series pattern of estimated earnings risk from repeated cross-section in this paper is likely to understate its actual increasing pattern.

2. Estimation of Earnings Variances

1) Overall Patterns of Earnings Variances

In applying the model developed in the previous section to data, an individual's earnings need be decomposed into the parts accountable by observable and unobservable characteristics. A regression as in equation (1) can achieve this, and I use 4 levels of education (less than high-school, high-school, some college, and college graduate) fully interacted with single-year age as the observable characteristics. For each education ? age cell, I obtain the mean of log wages, which is subtracted from individual worker's log wages to obtain his/her residuals as below.

$$\xi_{it}^{c} = \log(W_{it}^{c}) - \log(W_{cat}) \tag{8}$$

In the above, $\log(W_{eat})$ is the mean log wages of workers of age a $(=t-c)$ with education e at time t. The residual, ξ_{it}^{c}, is identical to the residual obtained from regressing individual log wages to fully interacted set of education and age dummy variables for each year. I use two earnings measures, monthly earnings and hourly earnings (=monthly earnings/monthly hours).

In each year, I sample data on 25~54 years old wage/salary workers from the WSS, and define 120 cells over 4 levels of education and 30 single-year ages. For each cell, I calculate mean log wages, M_{eat}, and their variances, V_{eat}, where e, a, and t represent education, age and year, respectively. Gender subscript is abstracted for notational simplicity. Further, I define time-invariant distribution of workers, s_{ea}, as the average share of workers of age a with education e as a fraction of total workers over the period 1978~2003. That is, $s_{ea}=\sum_{t=1978}^{2003} s_{eat}/26$ where s_{eat} is the share of workers of age a with education e as a fraction of total workers in year t.

For any subset of workers, G, its mean log wages (M_{Gt}) and variances (V_{Gt}) are calculated in the following way using the fixed demographic weights.

$$\begin{aligned} M_{Gt} &= \sum_{j\in G} s_j M_{jt} \Big/ \sum_{j\in G} s_j, \\ V_{Gt} &= \sum_{j\in G} s_j \{ V_{jt} + (M_{jt} - M_{Gt})^2 \} \Big/ \sum_{j\in G} s_j \end{aligned} \tag{9}$$

By using the time-invariant distribution of workers, I abstract from any changes in means and variances of wages that may arise from a change in worker composition.

Now the overall variances of log wages, V_t, can be decomposed as below.

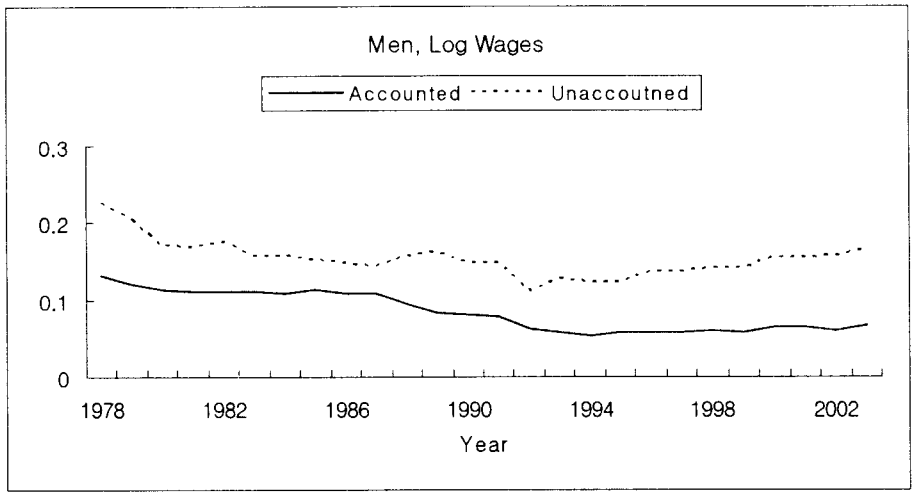
$$V_t = \sum_j s_j \{ V_{jt} + (M_{jt} - M_{Gt})^2 \} = \sum_j s_j V_{jt} + \sum_j s_j (M_{jt} - M_t)^2 \tag{10}$$

The above indicates that the variance of earnings can be decomposed into "unaccounted" and "accounted" variances, which are the first and second terms in right-hand-side of the

equation, respectively. The accounted variances represent changes in wage structure over age and education, and any widening or narrowing gaps between young and old workers, or between less and more educated workers, contribute to changes in earnings variances. The unaccounted variances, which are the main focus of this paper, represent variability in returns to unobserved skills and temporary variability in earnings.

Fig. 3 shows the time-series pattern of both accounted and unaccounted variances of log wages for the 1978~2003 period. The accounted variances had been on a declining trend until the mid-1990s, when they started to increase slightly. Unaccounted variances started to increase somewhat earlier in 1992.[11] Fig. 4 replicates Fig. 3 for log hourly wage rates, where hourly wage rates are defined as the monthly wages divided by monthly hours including overtime. There is little difference between log wages and log hourly wages in time-series pattern of their variances. Unaccounted variances started to increase earlier and more clearly than accounted variances, which shows only a small increase since the mid-1990s.

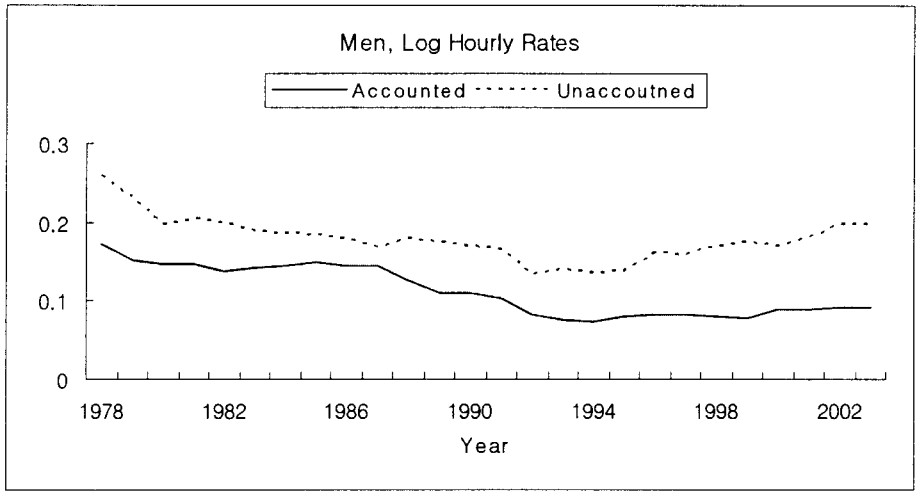
Fig. 3. Variance of Log Wages, Accounted and Unaccounted



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

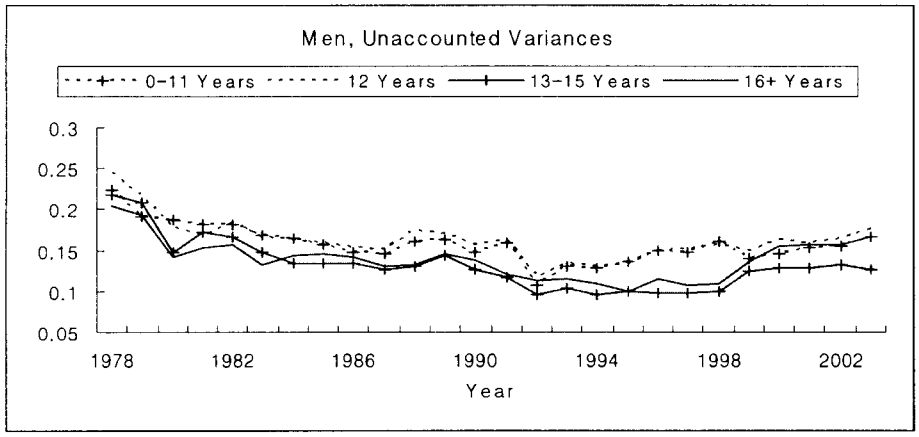
11) R^2, measured as the ratio of accounted to total variances, are .349 on average during the 1978~2003 period.

Fig. 4. Variance of Log Hourly Wage Rates, Accounted and Unaccounted



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

Fig. 5. Unaccounted Log Wage Variances by Education



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

It is important, however, to note that time-series patterns of *unaccounted* variances are quite similar between log wages and log hourly wages. They all had been on a declining trend throughout the 1980s and till 1992, since when they all started to increase. It is interesting that the turning point, 1992, was the year in which Korea's

stock market was opened, though partially, to foreign investors.

Fig. 5 compares time-series patterns of unaccounted log wage variances across education groups. It indicates that the common increase of unaccounted variances since 1992 is likely to reflect the changes in unaccounted variances of less-educated workers. Unaccounted variances of log wages clearly started to increase in 1992 among those with 12 or less years of education, while the increase in unaccounted variances was less clear until the late-1990s among those with at least some college education. Though not reported here, the educational patterns of unaccounted variances of log hourly wages are virtually the same.

2) Decomposing Unaccounted Variances

Unaccounted variances of log wages and hourly wages include both permanent and transitory components. Given that only age and education are used to measure accounted differences in log wages (and hourly wages), much of worker skills is still unmeasured. The unmeasured skill (or human capital component) can be considered as an individual fixed effect, although earnings accruing to it may not be time-invariant as skill price may change. This was already modeled in the previous section through equations (2)~(4). In this section, I estimate the earnings dynamics parameters as modeled in section 2 from repeated cross-sections extracted from the Wage Structure Surveys.

The estimation results from fitting equation (7) produces the parameter estimates as in Table 2. In the estimation, 53 birth-year cohorts (born between 1925 and 1977) are used.[12] The estimate of ρ^2, the coefficient on lagged log wage variances, is positive and located between (0, 1) as predicted by theory, and statistically significant. They tend to be greater for log wages than for log hourly wages. Further, the estimate of $(1-\rho^2)\sigma_\eta^2$, the coefficient on the time past since market entry, is also positive as predicted by theory, and statistically significant. The adjusted-R^2s are quite close to 1, indicating the substantial explanatory power of the model.

12) The 25~54 years old sample between 1978 and 2003 contain those born in 1924 and 1978, too, but they have only one observation each. Thus they are not included in the estimation.

Table 2. Estimation of Earnings Dynamics Parameters (Repeated Cross-Sections)

Coefficient	Men	
	Wage	Hourly Rates
ρ^2	.616 (.029)	.732 (.026)
$(1-\rho^2)\sigma_\eta^2 \times 100$	.221 (.013)	.264 (.017)
Adjusted R^2	.993	.993

Note: Standard errors are provided in the paratheses.

As the regression gives the estimates for ρ^2 and $(1-\rho^2)\sigma_\eta^2$, the estimates for ρ and σ_η^2 and their standard errors need to be imputed. For this, I carry out a simple simulation illustrated below. First, I draw 100,000 random values, namely z, from standard normal distribution, and impute the estimates of ρ and σ_η^2 as $\hat{\rho}(z) = \sqrt{\widehat{\rho^2} + \mu_{\rho^2} z}$ and $\widehat{\sigma_\eta^2}(z) = (\hat{B} + \mu_B z)/(\widehat{\rho^2} + \mu_{\rho^2} z)$ where $\hat{B}$ is the estimate of $(1-\rho^2)\sigma_\eta^2$ and μ_x is the standard error of the estimate of x. Then I take the mean values of $\hat{\rho}(z)$s and $\widehat{\sigma_\eta^2}(z)$ to impute the estimates of ρ and σ_η^2 and their standard errors. The results are reported in Table 3.[13]

13) The currently available panel data set in Korea covers the post-1998 period (the KLIPS), and it is used to estimate the model for comparison with the estimates from repeated cross-sections in Table 3. There is a small sample problem with the panel data, as the average cell size is only 53 when observations are grouped into birth-year cohorts. Cell size is as small as 8 in a few cohorts. This prohibits me from using cohort variations, and the precise comparison between the panel data and the repeated cross-sections is impossible. Thus just for a rough comparison, I ignore cohort effects in estimating the model from the panel data. From the panel, ρ is estimated to be .644 (.060). These are somewhat smaller than those from the repeated cross-sections estimates (.785), but not too different from them. The panel estimates for ρ_η^2 are 1.399? 0^{-2} with a standard error .647? 0^{-2}. These are somewhat larger than those from the repeated cross-sections, but given that the panel is short and cohort effects are ignored, these differences do not appear to be large. This comparison, though undoubtedly a limited one, suggests that the estimates from repeated cross-sections reasonably well approximate the true earnings dynamics in Korea. Further Moffitt and Gottschalk (1995) estimates the ρ to be .641 among white males in the US for the 1969~1987 period from the Panel Study of Income Dynamics data using a similar model. This estimate is also quite comparable to those reported in this Table 3.

Table 3. Imputed Estimates and Standard Errors of ρ and σ_η^2

	Men	
	Wage	Hourly Rates
ρ	.785 (.019)	.855 (.015)
σ_η^2? 00	.579 (.056)	.994 (.012)

Note: Standard errors are provided in the paratheses.

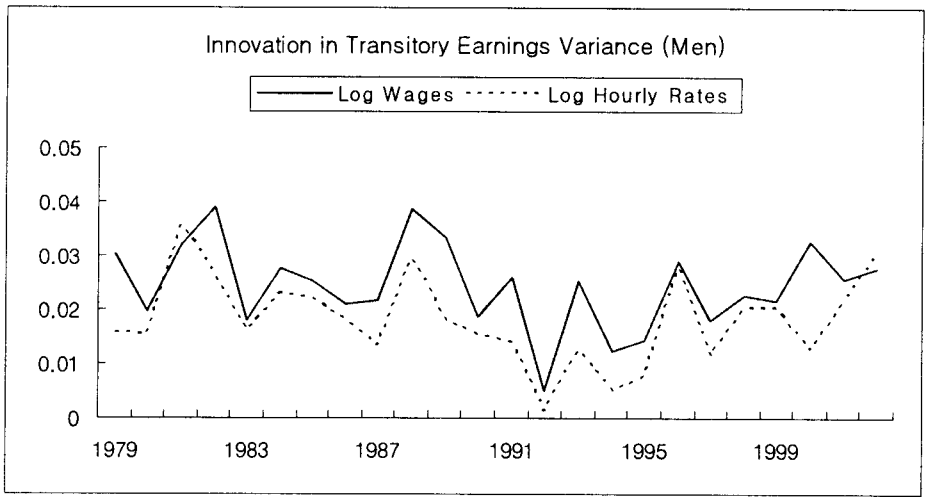
That being said, $A^c = (1-\rho^2)\sigma_{ut^c}^2 + \rho^2\sigma_\eta^2 + \sigma_\epsilon^2$ in equation (7) is estimated as the sum of constant and the coefficient on cohort dummy variable, and ω_t is estimated as the coefficient on year dummy variable. The estimates of ρ^2, ρ, and σ_η^2 in Tables 1 and 2 and A^c, however, let only $(1-\rho^2)\sigma_{ut^c}^2 + \sigma_\epsilon^2$ be identified, but not $\sigma_{ut^c}^2$ and σ_ϵ^2, individually. This is not a serious identification problem because I am interested only in time-series pattern of variances, not their levels. I can choose a value of σ_ϵ^2 which would yield positive values for $\sigma_{ut^c}^2$ given A^c, and also positive values for $\sigma_{\epsilon t}^2 = \sigma_\epsilon^2 + \omega_t$ given ω_t. In fact, I can determine the range of σ_ϵ^2 in which all the unidentified variance parameters will have a positive value, and choose a middle value from the range for σ_ϵ^2. This arbitrary choice of σ_ϵ^2 will affect not affect the time-series pattern of $\sigma_{\epsilon t}^2$ as it is mainly determined by ω_t.

Given the choice of σ_ϵ^2, $\sigma_{ut^c}^2$s are identified from A^cs, which are used to identify the variance of transitory earnings component σ_{vt}^2 from the equation below.

$$Var(\xi_{it}) = \sum_a s_a Var(\xi_{it}^c) = \sum_a s_a \sigma_{ut}^2(t-a) + \sigma_{vt}^2 \tag{11}$$

a is age, $t-a$ is birth-year, s_a is the share of age group a in population, and $\sigma_{ut}^2(c) = \sigma_{ut^c}^2 + (t-t^c)\sigma_\eta^2$. Note that σ_{vt}^2 can be recovered from the equality $\sigma_{vt}^2 = \rho\sigma_{vt-1}^2 + \sigma_{\epsilon t}^2$ as well, given that I have the estimates of ρ and $\sigma_{\epsilon t}^2$. The robustness

Fig. 6. Variances of Innovations in Transitory Component (Median σ_ϵ^2)



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

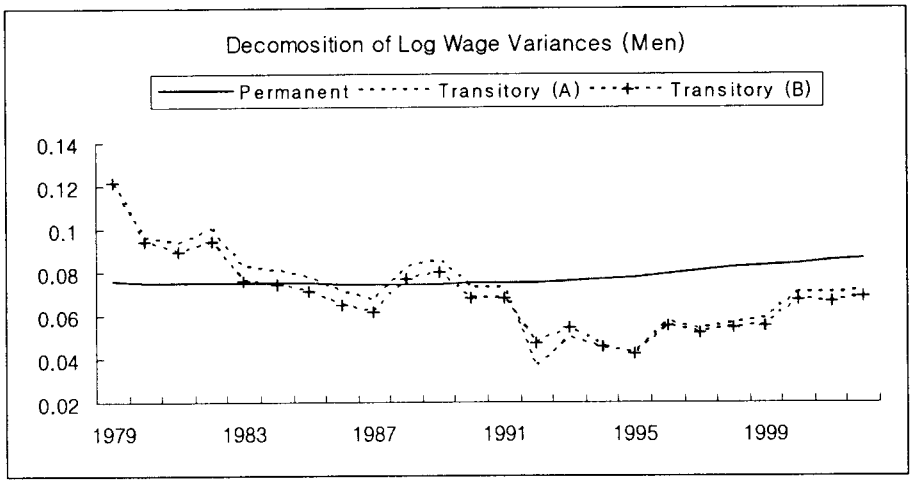
of the estimates thus can be indirectly tested by comparing the estimates of σ_{vt}^2 from the two sources. Again, the choice of σ_ϵ^2 will affect only the levels of σ_{ut}^2 (c)s and σ_{vt}^2s, not their time-series pattern.

Fig. 6 plots the estimates of $\sigma_{\epsilon t}^2 = \sigma_\epsilon^2 + \omega_t$ where the median values of σ_ϵ^2 is chosen for the two earnings measures, log wages and log hourly wage rates. The variances of innovations in transitory component show some cyclical movement with a clear break in trend in 1992. For both log wages and log hourly wages, the variances had been declining until 1992 when they started to switch into an increasing trend.

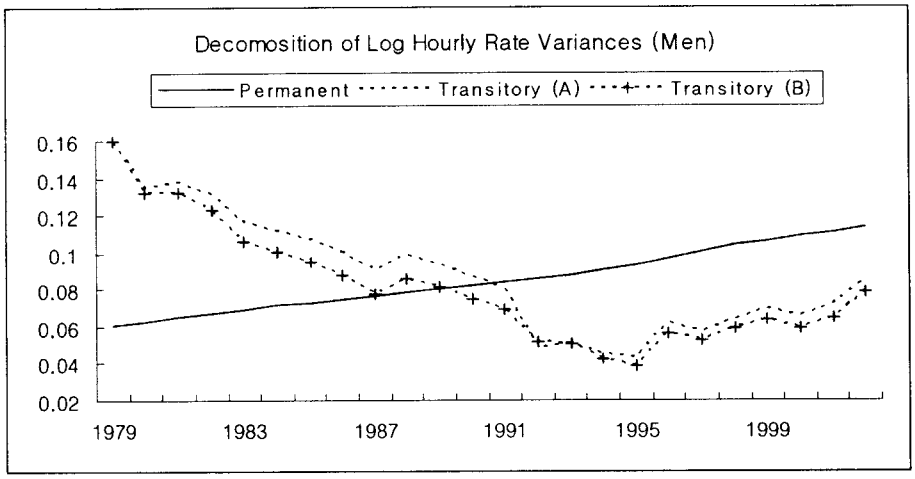
Total unaccounted earnings variances $Var(\xi_{it})$ are decomposed into the variances of permanent and transitory earnings component, which are plotted in Fig. 7. The permanent variances are calculated from the equality, $\sigma_{ut}^2 = \sum_a s_a \sigma_{ut}^2 (t-a)$, and the transitory variances are calculated from the two methods explained above. In the figure, Transitory (A) represents σ_{vt}^2 estimated by subtracting σ_{ut}^2 from $Var(\xi_{it})$, and Transitory (B) represents σ_{vt}^2 recovered from the equality $\sigma_{vt}^2 = \rho\sigma_{vt-1}^2 + \sigma_{\epsilon t}^2$.

Fig. 7: Decomposition of Unaccounted Earnings Variances (1979~2002)

(1) Log Wages



(2) Log Hourly Wage Rates



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

Fig. 7 indicates that the variances of permanent component, σ_{ut}^2, have steadily been increasing throughout the period in both log wages and log hourly wage rates. As the only time-varying dimension in the variances of permanent component is cohort composition in my model, the increasing trend of σ_{ut}^2 implies that recent cohorts have a

larger $\sigma^2_{ut'}$, or the variance of permanent component at entry level. The variances of transitory component, σ^2_{vt}, have similar U-shaped time-series pattern in all figures.

3) Discussion

One of the significant shortcomings of using repeated cross-sections instead of panel data is that I have to restrict the variance of permanent innovation in earnings, σ^2_η, to be time-invariant. This restriction is placed for the purpose of identification.[14] However, given that the variance of transitory innovation in earnings, $\sigma^2_{\epsilon t}$, shows an increasing trend since 1992, there is the possibility of a similar trend in σ^2_η, ignoring which renders imprecise estimates for the parameters.

The model used to estimate time-specific variances of permanent innovation in earnings is quite limited. One may allow a one-time change in σ^2_η during the period, probably between the pre-1992 and post-1992 periods, but such division of the periods is only too arbitrary. It indeed produces a greater estimate for σ^2_η for the post-1992 period, though the estimate depends somewhat on the period division. When the pre-1992 and post-1992 periods are used, σ^2_η is estimated to increase from .121? 0^{-2} to .791? 0^{-2} in monthly earnings.

This result supports the conjecture that the variance of permanent innovation in earnings has also increased during the 1990s. However, this one-time increase in σ^2_η is undoubtedly a restrictive assumption, and it cannot fully capture the true changes in earnings variance structure. To the extent that the time-varying part of $\sigma^2_{\eta t}$ is not fully captured by the constant estimate of σ^2_η (or by a one-time increase in σ^2_η), the time-series pattern of variances of transitory innovation will contain some uncaptured part of variances of permanent innovations. That would lead to a bias in ρ toward 1.[15]

---

14) If a panel is available, one can estimate time-varying variances of permanent innovation in earnings, $\sigma^2_{\eta t}$, as well as time-varying variances of transitory earnings innovation, σ^2_{vt}, through GMM (minimum distance) estimation. See Krebs, Krishna and Maloney (2002) for example.

IV. Capital Market Openness and Earnings Variability

The time-pattern of variances of transitory innovation in earnings indicates that earnings risk started to increase in the early 1990s, which coincided in timing with the increase in FDI inflow and stock market opening. This finding motivates me to focus on these two types of capital in identifying the potential effects of capital market opening on earnings risk.

Fig. 8 plots the estimated variances of transitory innovation ($\sigma^2_{\epsilon t}$) against the share of foreign capital in total capital stock and also against the share of foreign capital in total equity stock in Korea. Earnings risk had not be quite correlated with the share of FDI capital in total capital stock until the early 1990s, but there appears a positive relationship between earnings risk and FDI capital during the 1990s, as shown in panel (A) of the figure. The correlation coefficient between the two series for the entire period is estimated at .122, but much greater at .550 for the 1990s. Thus it appears that the correlation, if any, between earnings risk and FDI arose when the FDI inflow started to grow rapidly.

Panel (B) of the Fig. shows that foreign capital's presence in Korea's equity market is also correlated (over time) with the growing pattern of earnings risk. The panel plots only for the post-1992 period as stock market was opened to foreign investors in 1992, and the correlation coefficient between earnings risk and the foreign share in total equity stock is estimated at .683.

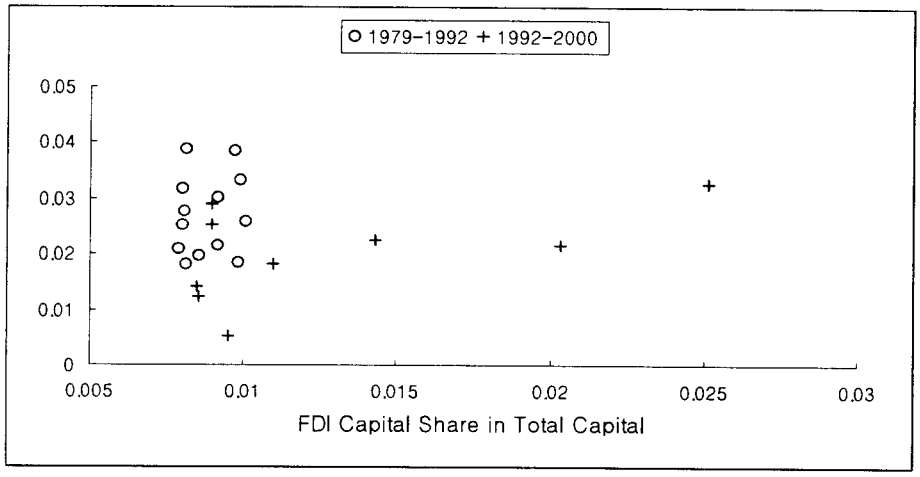
Comparison of time-series pattern of earnings risk and capital market opening is suggestive, but it is also subject to the risk of picking up spurious correlations. One can use cross-section variation to avoid it, and I adopt industry variations for the purpose.

---

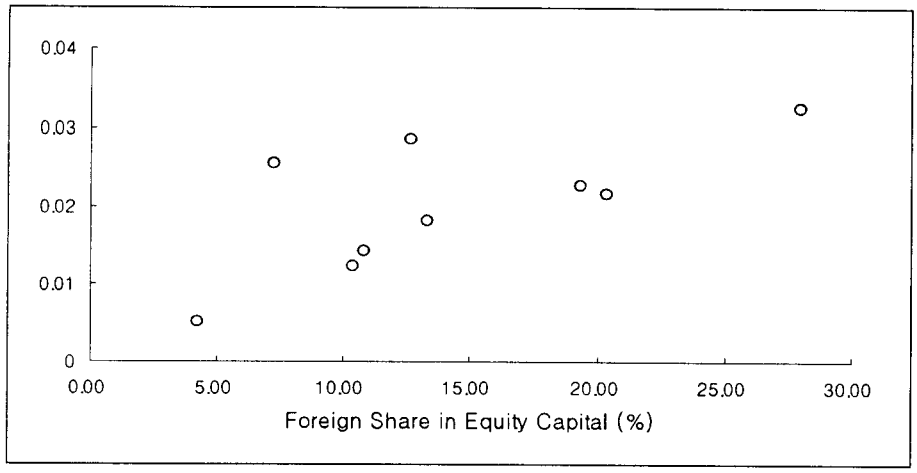
15) ρ is estimated at .618 in the model allowing a one-time increase in σ^2_η, which is somewhat smaller than .785 in Table 3.

Fig. 8. Earnings Risk (σ^2_{et}) and the Presence of Foreign Capital

(A) Earnings Risk against FDI Capital Share (1979~2000)



(B) Earnings Risk against Foreign Equity Capital Share (1992~2000)



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

There are two points worth discussion, theoretical and empirical, in identifying the effect of foreign capital presence on workers' earnings risk from industry-level data. First, FDI and equity investment are very different in nature and probably so in terms of their effects on workers. FDI into an industry increases physical capital stock in the industry

and is likely to affect the labor demand in the industry through the conventional changes in marginal productivities. Thus the linkage between FDI and labor demand at industry level is rather clear. However, equity investment in a firm may not affect the marginal productivity of the factors employed in the firm as it often means a simple change of ownership of the outstanding stocks. Volatility in stock prices induced from rapid inflow and outflow of foreign capital in equity market may lead to overall increase in earnings risk of workers, but it is not clear whether such connection would exist at industry level. Instead, it may affect labor demand or employment decisions of a firm in two other ways.[16] First, foreign shareholders, if their shares are sufficiently large, may affect the firm's labor management practice. For example if foreign investors are more interested in short-term gains than domestic investors, labor management can be affected in such a way that short-term profits are put ahead of long-term growth potentials. Second, net purchase of domestic stocks may induce a rise in stock price, which may induce the firm to increase investment (as in Tobin's q).[17] To the extent that domestic investment is "induced" by equity investment of foreign capital, equity investment and labor demand can be linked at industry level.

The second, and empirical, problem is that inflow of foreign capital into various industries, through FDI or equity investment, may be endogenous. In particular when equity investment targets high short-term gains in riskier sectors, whether labor costs can be easily contained can be an important factor in decision making. For example, foreign investors may prefer non-union firms as labor costs tend to be higher and difficult to reduce in union firms even when they struggle. To the extent that greater earnings risk of workers reflect the easiness to adjust wage and jobs in a firm, foreign investors may prefer sectors with greater earnings risk of workers. Below I use instrumental variables to control for such potential endogeneity.

These being said, I use industry-time variation to identify the effects of foreign capital

16) Investment on newly issued stocks increases capital of a firm, and thus affects marginal productivity of factors of the firm in a similar way as FDI. This is an additional channel through which equity investment and labor demand can be linked at industry level.

17) This explanation may require the assumption that foreign investors have better, or at least, different information than domestic investors, which is not readily certifiable.

presence of varying types on earnings risk of workers in Korea. As was briefly shown in Table 1, industries differ in the presence of foreign capital and its increase. For example in 2003, the share held by foreign investors was as high as 45.9% and 42.7% in communication and manufacturing, and was as low as 17.8% in personal and other services. The comparable figures were 13.1%, 8.9% and 0.0% in 1996. I believe that this industry-level variation is sufficiently large for my analysis.

Earnings variability at industry level is estimated by applying a version of equation (7) which allows a one-time change in the variance of permanent innovation in earnings in each industry. In particular, equation (7-1) below is estimated at industry level.

$$Var(\xi_{it}^{cj}) = A^{cj} + B_1^j(t-t^c) + B_2^j(t-t^*)I(t \geq t^*) + \rho_j^2 Var(\xi_{it-1}^{cj}) + \omega_t^j$$

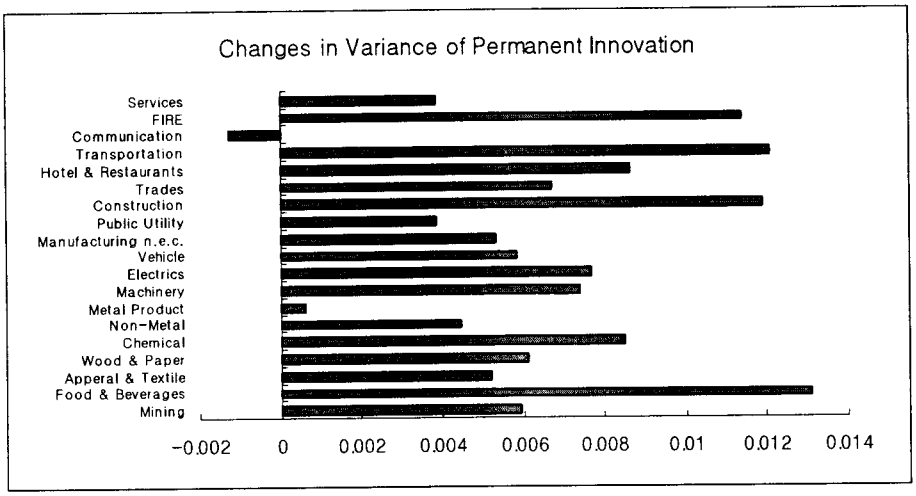
$$\text{where} \quad B_1^j = (1-\rho_j^2)\sigma_{\eta j}^2 \ , \ B_2^j = (1-\rho_j^2)\Delta\sigma_{\eta j}^2 \ , \ \text{and} \qquad (7\text{-}1)$$

$$A^{cj} = (1-\rho_j^2)\sigma_{ujt^c}^2 + \rho_j^2(\sigma_{\eta j}^2 + \Delta\sigma_{\eta j}^2 I(t^c \geq t^*)) + \sigma_{\epsilon j}^2$$

The above equation is different from equation (7) in that it allows the variance of permanent innovation in earnings to change one-time at t^* by $\Delta\sigma_{\eta j}^2$. Thus the effects of the presence of foreign capital (or capital market opening), if any, are considered to be linked to the magnitude of $\Delta\sigma_{\eta j}^2$ and the post-opening time pattern of $\sigma_{\epsilon jt}^2 = \sigma_{\epsilon j}^2 + \omega_t^j$ across industries. The point of such change is chosen to be the year 1992, when both FDI inflow and equity investment started to pick up pace. The purpose of this variation is to decompose the effects of foreign capital presence into those on permanent and transitory innovations in earnings.

Fig. 9 plots the estimated one-time change in the variance of permanent innovation in earnings ($\Delta\sigma_{\eta j}^2$). There appears to be some non-trivial differences in the changes in variances of permanent innovation among industries. Most industries show an increase in the variances of permanent innovation in earnings except for communication, and manufacturing sectors tend to show a smaller increase. However, this cross-industry pattern of $\Delta\sigma_{\eta j}^2$ is not quite associated with industrial pattern of foreign capital presence. The weighted correlation between $\Delta\sigma_{\eta j}^2$ and the average share of foreign capital in

Fig. 9. One-time Change in the Variance of Permanent Innovation in Earnings across Industries



Source: The author's calculation from Wage Structure Survey (Ministry of Labor)

Note: F.I.R.E. represents finance, insurance and real estate service.

equity market across industries is estimated at .131 and insignificant. The weighted correlation between $\Delta\sigma^2_{\eta j}$ and the average share of FDI captial in total capital stock across industries is estimated at .142 and insignificant, again. These results suggest that foreign capital presence, through FDI or equity market, does not have had a significant influence on the increase in variances of permanent innovation in earnings.

I now turn to the variances of transitory component in earnings, and its industry-time pattern. I look for any correlation between the estimated ω^j_t in equation (7-1) and foreign capital presence across industry (j) and time (t). In particular, I estimate the following OLS equation to see the correlation.

$$\omega^j_t = \alpha + \beta k^j_t + \delta_j + \theta_t + \nu^j_t \tag{12}$$

In the above, δ_j and θ_t capture industry-specific and time-specific components in the variances of transitory innovation in earnings. k^j_t is the share of foreign capital in

various forms in industry j at time t, and β measures the effects of foreign capital presence on the variances of transitory innovation in earnings. FDI inflow and outflow data are obtained from the Ministry of Commerce, Industry and Energy, and they are converted into stocks using a depreciation rate of 4% a year.[18] Foreign share in the equity market is obtained from Koscom, a Korean company that keeps and processes equity market data in electronic forms.

Table 4 shows both the OLS and 2SLS estimation results. The OLS estimates are given in Panel (A) and the 2SLS estimates using the lagged values of foreign equity and FDI capital shares as instruments are given in Panel (B). The columns in each panel differ from each other in the types of capital used as the regressor. Column (1) uses FDI capital share in total capital stock, (2) uses foreign shares in total equity, and (3) uses both capital measures. All equations include sector and year dummy variables to control for sector and time-specific effects.

Panel (A) in Table 4 indicate that the OLS estimates for the effect of foreign capital presence are mostly positive, but the estimated effects of FDI capital on earnings risks are statistically insignificant.[19] The presence of foreign capital in equity market on earnings risk has a much smaller effect on earnings risk, but they are statistically significant in these OLS regressions, suggesting the possible association between foreign equity holding and earnings risk. When the potential endogeneity in regressors is controlled for with lagged values of the regressors being used as instruments, however, the coefficients on both types of foreign capital presence lose statistical significance although they remain positive.[20]

---

18) I tried several other values of depreciation rate, and obtained qualitatively the same results, which means that the results are rather independent of the choice of depreciation rate.

19) This result is consistent with Mah (2003) who finds no effect of FDI on income inequality between 1975 and 1995. He does not consider the stock market opening, however, as his data cover only the pre-opening period.

20) One notable pattern is that the coefficient on FDI tends to increase while that on equity decreases when instrumental variables are used. Given that the instruments are expected to control for the endogeneity in FDI inflow and equity capital investment by foreigners, the changes in coefficients suggest the possibility that these two types of foreign capital inflow have different motivations. In particular, it is probable that foreign investment on the Korean

Table 4. Effects of Foreign Capital on Variances of Transitory Innovation

(A) OLS Estimates

	(1)	(2)	(3)
FDI Capital Share	.086 (.103)	-	.069 (.145)
Equity Share	-	.021 (.011)*	.019 (.012)
Sector & Time Dummy	Yes	Yes	Yes
No. of Obs.	162	90	90
R^2	.368	.295	.297

(B) 2SLS Estimates

	(1)	(2)	(3)
FDI Capital Share	.234 (.252)	-	.197 (.317)
Equity Share	-	.013 (.019)	.004 (.023)
Sector & Time Dummy	Yes	Yes	Yes
No. of Obs.	72	72	72
R^2	.318	.310	.323

Note: **; significant at 5% risk, *; significant at 10% risk
FDI capital share data are available for 18 sectors in the 1992-2000 period, and the foreign share in equity data are avaliable for the 1996-2003 period. As a result, the last columns use only 5-year data (1996-2000).
Data: Ministry of Commerce, Industry and Energy, Koscom.

The results in Table 4 offer no strong evidence for the effect of foreign capital presence on earnings risk. Two points need consideration. First, because industry-level association between equity capital and earnings risk is not well defined in terms of theory, one needs to keep in mind that the power of test using cross-section data is not high at least as far as equity foreign equity share is concerned. To put it another way, one needs to keep in mind the "unproven" possibility that the effects of foreign capital presence in equity market may appear mostly at aggregate-level. Second, as discussed previously, the effect of foreign capital presence may show up differently among workers of varying skills. If so, no systematic pattern found in Table 4 may be an artifact of the offsetting effects among workers of varying skill levels. Such offsetting

stocks is motivated more by short-term gains, and thus is concentrated in sectors in which workers are more vulnerable.

Table 5. Effects of Foreign Capital by Educational Groups

(A) OLS Estimates

(1) High School or Less	(1)	(2)	(3)
FDI Capital Share	.275 (.129)**	-	.394 (170)*
Equity Share	-	.033 (.015)**	.021 (.015)
Sector & Time Dummy	Yes	Yes	Yes
No. of Obs.	162	90	90
R^2	.211	.260	.316
(2) Some College or More	(1)	(2)	(3)
FDI Capital Share	-.252 (.114)**	-	-.476 (.164)**
Equity Share	-	.012 (012)	.027 (.013)**
Sector & Time Dummy	Yes	Yes	Yes
No. of Obs.	162	90	90
R^2	.468	.465	.526

(B) 2SLS Estimates

(1) High School or Less	(1)	(2)	(3)
FDI Capital Share	.778 (.311)**	-	.741 (.384)*
Equity Share	-	.038 (.025)	.005 (.029)
Sector & Time Dummy	Yes	Yes	Yes
No. of Obs.	72	72	72
R^2	.285	.247	.045
(2) Some College or More	(1)	(2)	(3)
FDI Capital Share	-.499 (.246)**	-	-.639 (.325)*
Equity Share	-	-.014 (.017)	.015 (.023)
Sector & Time Dummy	Yes	Yes	Yes
No. of Obs.	72	72	72
R^2	.554	.542	.549

Note: **; significant at 5% risk, *; significant at 10% risk

FDI capital share data are available for 18 sectors in the 1992-2000 period, and the foreign share in equity data are avaliable for the 1996-2000 period.

Data: Ministry of Commerce, Industry and Energy, Koscom.

effects are probable as the literature suggests that capital is more complementary to skilled labor (e.g. Krusell et al, 2000). Also, Fig. 5 previously indicated that earnings risks had not started to increase until the late 1990s among those with higher education,

which is also suggestive of the possibility of varying effects of foreign capital on workers of varying skill levels.

Table 5 reports the results of the same equations as in Table 4 for two separate worker groups - workers with a high school diploma or less, and workers with at least 2-year college degree. For each education group, equation (7-1) is separately estimated to obtain the estimate of ω_t^j, which is regressed on the two types of capital shares, sectoral and time dummy variables. Although the foreign capital share in equity is not expected to have discernably different effects on workers of varying skills, the capital variable is included in the regressions to double-check the possibility.

Table 5 indicates that there is a notable difference between educational groups in terms of the effects of foreign capital. The presence of foreign capital in equity market is estimated to have no strong effect on either educational group, and the results are the same between the OLS and 2SLS estimations. The FDI capital, however, is estimated to have the significantly opposite effects on workers with high-school diploma or less and those with 2-year college education or more. Both the OLS and 2SLS estimates indicate that the share of FDI capital in total capital stock increases the earnings risk of less educated workers while it decreases that of more educated workers. The variance of transitory innovation in earnings ($\sigma_{\epsilon t}^2$) is estimated to have increased by .038 among workers with high-school or less education between 1992 and 2000, and the 2SLS estimates indicate that the FDI capital presence account for .011~.012 out of the increase, or approximately 30% of the increase. The variance of transitory innovation in earnings has increased by .031 among workers with college education during the same period, and the 2SLS estimate indicates that the increase would have been greater among them by .007~.010 if it were not for the increase in FDI inflow. This educational pattern is rather consistent with the common interpretation that capital is more complementary to skilled workers. For skilled workers are increasingly likely to perform core functions in a firm with greater capital and higher technology. Firms may find it profitable to maintain core workers' job and wage stability while sacrificing job and wage stability of less skilled workers.

Given that such differences in the FDI's effects on workers of varying education levels are likely to arise from the differences in complementarity between various workers and capital, it still remains to explain why "foreignness" of capital matters, not just the capital as a whole. If FDI were not different from domestic investment at all, only the overall investment rate would matter, not the "foreign" and "domestic" composition of total investment or capital stock. One explanation is that FDI capital may have a more advanced technology embodied in it. In fact, the data support this explanation. A simple OLS regression using industry-level variations indicates that the sectors with more skilled workers have attracted more foregin direct investment for the post-1992 period; a 10% point increase in the share of college educated workers in total employment increases the share of FDI inflow in total investment by 8.4% point for the post-1992 period.[21)]

V. Concluding Remarks

The empirical results obtained in this paper provide mixed evidence for a causal relationship between foreign capital presence and earnings risk among wage/salary workers. Although the time series pattern indicates that increased capital mobility during the 1990s coincided with the increase in earnings risk in Korea, the evidence for a cross-sectional linkage between the two is not strong. Presence of foreign capital tends to be positively associated with earnings risk of workers, but once the possible endogeneity in foreign capital inflow is controlled for, the association loses statistical significance. Thus more researches appear due to induce clearer implications on the effects of capital market opening on wage/salary workers' earnings risks.

One interesting finding, however, is that foreign capital presence may have some

21) When the share of FDI in total investment is regressed on the share of college educated workers in total employment at industry level, the coefficient is estimated at .842 with standard error .162.

implications on risk inequality. The results indicate that foreign capital through direct investment (FDI) has differential effects on workers of varying skill levels. In particular, the FDI capital tends to increase earnings risk among less educated workers while it tends to reduce the risk among workers with some college education or more. The results, which is partly attributable to the concentration pattern of FDI on skill-intensive sectors in Korea, are consistent with the notion that capital and skill are complementary. Thus the acceleration of FDI inflow during the 1990s in Korea, though it did not directly affect the level of earnings risk, must have contributed to an increase the gap in earnings risk between skilled and unskilled workers.

An increase in earnings risk does not always have a strong welfare implication. It depends on how easily earnings risk can be self-insured. The results in this paper indicate that the effects of capital market opening, if any, show up in transitory innovation in earnings, which in principle can be self-insured in a complete capital market. Permanent innovation in earnings, which is not self-insured, is shown to have not been affected by capital market opening. Given the findings, it is appropriate to conclude that capital market opening in Korea has not had a permanent welfare implication on workers through its effects on earnings risk. A short-term effect in terms of a widening risk gap between skilled and unskilled workers is probable as the transitory innovations are unlikely to have been fully self-insured due to capital market imperfection. Of course, capital market opening may have nontrivial welfare implications through other channels such as widening wage gaps, but they are not the concern of this paper. Thus the conclusion of this paper on welfare implication must be limited to the one through earnings risk and nothing else.

One caveat is that the earnings risks identified from the analysis are likely to leave out the risks associated with job loss. As the model builds on the use of repeated cross-section, job loss cannot be identified and taken into account to analyse the overall risks faced by workers. In that sense, the results in this paper underestimate the true risks workers are exposed to. This problem can be properly addressed when longer panel data sets become available.

References

Berman, Eli, John Bound, and Zvi Grillichs. "Changes in the Demand for Skilled Labor within U.S. Manufacturing: Evidence from the Annual Survey of Manufactures." *Quarterly Journal of Economics* 109 (2) (1994): 367-397.

Bertocchi, Graziella. "Labor Market Institutions, International Capital Mobility, and the Persistence of underdevelopment." *Review of Economic Dynamics* 6 (2003): 637-650.

Bourguignon, Francois, and Chor-ching Goh. "Trade and Labor Vulnerability in Indonesia, Republic of Korea nad Thailand," in H. Kharas and K. Krumm (eds.), *East Asia Integrates: A Trade Policy Agenda for Shared Growth.* Washington DC: World Bank and Oxford Univerity Press.

Bourguignon, Francois, Chor-ching Goh, and Dae Il Kim. "Estimating Individual Vulnerability to Poverty with Pseudo-Panel Data." mimeo, World Bank and Seoul National University.

Carrol, C., and Samwick A. "The Nature of Precautionary Wealth." *Journal of Monetary Economics* 40 (1997): 41-72.

Calvo, Guillermo A., and Enrique G. Medonza. "Rational Contagion and the Globalization of Securities Markets." *Journal of International Economics* 51 (2000): 79-113.

Cameron, Stephen, and Joseph Tracy. "Earnings Variability in the United States: An Examination using Matched-CPS Data." a paper presented at the 1998 Society of Labor Economics Conference.

Cline, William R. *Trade and Income Distribution.* Washington DC: Institute for International Economics.

Dasgupta, Indro, and Thomas Osang. "Globalization and Relative Wages: Further Evidence from U.S. Manufacturing Industries." *International Review of Economics and Finance* 11 (2002): 1-16.

Eckel, Carsten. "Labor Market Adjustments to Globalization: Unemployment versus Relative Wages." *North American Journal of Economics and Finance* 14 (2003): 173-188.

Ethier, Wilfred J. "Globalization, globalisation: Trade, Technology, and Wages." *International Review of Economics and Finance* 14 (2005): 237-258.

Feenstra, Robert C., and Gordon H. Hanson. "Globalization, Outsourcing, and Wage Inequality." *American Economic Review* 86 (2) (1996): 240-245.

Freeman, Richard B. "The Demand for Education." in Orley Ashenfelter and Richard Layard (eds.), *Handbook of Labor Economics* 1 (1986): 357-386, Amsterdam.

Hamermesh, Daniel S. "The Demand for Labor in the Long Run." in Orley Ashenfelter and Richard Layard (eds.). *Handbook of Labor Economics* 1 (1986): 429-471, Amsterdam.

Gourinchas, P., and J. Parker. "Consumption over the Life-Cycle." *Econometrica* 70 (2002): 47-89.

Haskel, Jonathan E., and Mathew J. Slaughter. "Does the Sector Bias of Skill-Based Technical Change Explain CHanging Wage Inequality?" *National Bureau of Economic Research Working Paper* #6565, (1998).

Johnson, George, and Frank Stafford. "The Labor Market Implications of International Trade." in Orley Ashenfelter and Richard Layard (eds.). *Handbook of Labor Economics* 3B (1999): 2215-2288, Amsterdam.

Kim, Dae Il. "Growth in College Education and Wage Differentials in Korea." *Seoul Journal of Economics* 18 (2) (2005).

Knight, Malcolm. "Developing Countries and the Globalization of Financial Markets." *World Development* 26 (7) (1998): 1185-1200.

Krebs, Tom, Parvin Krishna, and William Maloney. "Trade Policy, Income Risk, and Welfare." *NBER Working Paper* #11255 (2005).

Krusell, P., L. E. Ohanian, J. R.io-Rull, and G. L. Violante. "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis." *Econometrica* 68 (5) (2000): 1029-1054.

Lawrence, Robert, and Mathew Slaughter. "International Trade and American Wages in the 1980s: Giant Sucking Sound or Small hiccup?" in Martin N. Baily and Clifford Winston (eds.). *Brookings Papers on Economic Activity: Microeconomics* 2 (1993):

161-211.

Leamer, Edward E. "Wage Inequality from International Competition and Technological Change: Theory and Country Experience." *American Economic Review* 86 (2) (1996): 309-314.

Mah, Jai S. "A Note on Globalization and Income Distribution—the Case of Korea, 1975-1995." *Journal of Asian Economics* 14 (2003): 157-164.

Meghier, C., and L. Pistaferri. "Income Variance Dynamics and Heterogeneity." *Econometrica* 72 (2004): 1-32.

Moffit, Robert A., and Peter Gottschalk. "Trends in the Autocovariance Structure of Earnings in the U.S.: 1967-1987." Working Paper, Johns Hopkins University.

Nilsen, Jeffrey H., and Riccardo Rovelli. "Investor Risk Aversion and Financial Fragility in Emerging Economies." *Journal of International Financial Markets, Institutions and Money* 11 (3-4) (2001): 443-474.

Rodrick, D. *Has Globalization Gone Too Far?* Washington DC: Institute for International Economics.

Seshanna, Shubhasree, and Stéphane Decornez. "Income Polarization and Inequality across Countries: An Empirical Study." *Journal of Policy Modeling* 25 (2003): 335-358.

Storesletten, K., C. Telmer, and A. Yaron. "Cyclical Dynamics in Idiosyncratic Labor Market Risk." *Journal of Political Economy* (2004).

Wade, Robert H. "Is Globalization Reducing Poverty and Inequality?" *World Development* 32 (4) (2004): 567-589.

Wood, Adrian. *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World.* Oxford.

Wood, Adrian. "Give Heckscher and Ohlin a Chance!" *Weltwirtschaftliches Archiv* 130 (1) (1994b): 20-49.

Yoo, Gyeongjoon, and Dae Il Kim. *International Comparison of Income Inequality and Poverty* (in Korean). Seoul: KDI Press.

논문초록

자본시장 개방과 소득 변동성

김 대 일

본 논문은 우리나라 노동시장에서 1990년대에 소득 변동성이 증가한 양상을 실증적으로 추정하고, 이러한 소득 변동성의 증가가 자본시장의 개방에 의해 설명될 수 있는지 분석하였다. 소득 변동성 추정에 있어서는 패널 자료가 아닌 반복 횡단면 자료에 간단한 계량모형을 적용하여 임금소득의 일시적 변화와 항구적 변화에 대한 분산을 추정하였다. 1990년대 소득 변동성의 증가 추세는 1992년 주식시장 개방을 필두로 한 우리나라 자본시장 개방과 시기적으로 일치하는 것으로 보이나, 산업 차원에서의 횡단면 분석에 의하면 양자간의 인과관계는 강하지 않은 것으로 추정된다. 다만 외국인 직접투자의 경우 고학력 근로자의 일시적 소득 변동성은 줄이는 효과를, 저학력 근로자의 일시적 소득 변동성은 증가시키는 효과를 갖는 것으로 추정되었다. 이와 같이 근로자 유형별로 비중립적인 효과를 갖는 것은, 자본과 기능의 보완성에 따른 효과로 판단된다. 한편 일시적 소득 변동성이 자본시장에서 충분히 분산될 수 없다면, 이러한 외국인 직접투자의 비중립적 효과는 "임금소득의 변동성"이라는 측면에서 근로자 유형별 복지의 격차를 유발시킬 가능성이 있다고 판단된다.

주제어: 소득 변동성, 자본시장 개방, 자본과 기능의 보완성